Subvar. nov.—Sides blackish, back greyish; margin of sole light brown. Yorkshire (*Collinge*).

Subvar. nov.—Animal drab colour; foot deep yellow, margin bright orange. Guernsey (*Roebuck*).

After a careful examination of a number of brown and red forms of *A. empiricorum* I am much inclined to group Mr. Roebuck's var. *brunneus* as a subvar. of var. *rufus*, L. The variety *subreticulatus*, Ckll., might also be grouped as a subvariety of var. *reticulatus*, Roebuck. There can be little doubt but that the var. *fallax*, Ckll., of *A. hortensis*, Fér., is merely a form of var. *subfusca*, C. Pfr. The var. nov. *albipes* lately described by Mr. Cockerell * is a very unsatisfactory one, being made from a single immature specimen. The white sole is such an unusual occurrence in *A. hortensis* that it is important; but specimens frequently show light-coloured soles in a young condition.

The many perplexing forms of *Arion* which are at present engaging the attention of conchologists cannot be rightly assigned to this or that species from a mere examination of the external parts, and it is to be hoped that future collectors will abstain from adding useless synonyms to the list until they obtain a better knowledge of the anatomy.

XLVIII.—*Notes on Dr. W. Kükenthal's Discoveries in Mammalian Dentition.* By Oldfield Thomas.

The two important papers by Dr. W. Kükenthal recently published †, and translated in the present number of the 'Annals' ‡, render necessary a few words on the bearing that the discoveries therein announced have on the theories of tooth-descent current here and on the Continent.

On the first and most essential question as to the origin of the present Mammalian diphyodontism, *i. e.* the possession of two more or less complete sets of teeth, a milk and a permanent set, two conflicting views have been advocated—(1.) that this diphyodontism was present in the earliest Mammalia, and has become reduced in the different orders to different degrees, the lowest orders being paradoxically the most

* 'The Conchologist,' vol. i. p. 33 (1891).
† Anat. Anz. vi. pp. 369 and 658 (1891).
‡ *Supra*, pp. 279, 285.

advanced in reduction; and (II.) that Mammals were primitively monophyodont and that the milk-dentition was superadded as a secondary development, the development being naturally most advanced in the highest orders.

The latter view was adopted and carried out in great detail by myself *, and therefore now that Dr. Kükenthal's discoveries have shed a new light on the subject I am impelled to express the revised opinion that they have induced me to form.

The second of the two theories referred to had as its primary basis the nearly complete monophyodontism of the Marsupials, and the moment these were proved to have been ever more largely diphyodont than they are at present the whole case would fall to the ground. And such proof seems now to have been found by Dr. Kükenthal in the nearly complete set of rudimentary successional teeth discovered by him in embryos of *Didelphys*; which can hardly be interpreted otherwise than he has done, namely as rudiments of a previously functional second set of teeth.

Such being the case I am now for my own part prepared to admit that Mammals must have been originally diphyodont and that their regular diphyodontism was probably in direct succession to the irregular polyphyodontism of their Reptilian ancestors, or may even have existed in what were in other respects members of the latter class.

At the same time it is evident that on this view many of the known facts seem to become more instead of less difficult of interpretation. Thus the fact that *Triconodon*, one of the earliest known Mammalia, changed a single tooth only †, and that the very one which changes in the modern Marsupials, now appears most inexplicable, and is alone almost calculated to stagger belief in primitive diphyodontism.

This problem, however, may be left for time to unravel, but its existence is sufficient to excuse those who, before these latest discoveries were made, could not bring themselves to believe in that view of the ancestral history of Mammalian teeth.

The same fact, combined with the presence of four undoubted premolars (of whichever "series") in so many of the earliest Marsupials, renders it also difficult, if not impos-

* Phil. Trans. 1887, p. 443.

† The specimen of *Triconodon* (*Triacanthodon*) figured in my paper has, by the kind permission of Dr. Woodward, been carefully developed beneath all the cheek-teeth, and reexamined by the light of Dr. Kükenthal's discoveries. No other successional teeth, however, besides that below $p.^4$ are present in the jaw.

sible, to follow Dr. Kükenthal in his homologization of the changing tooth of Marsupials with $p.^3$ instead of $p.^4$, as it has usually been considered to be, even if the missing premolar has left no trace of its former presence in the position (next anterior to "$p.^3$") which I suggested it had most probably occupied. The problem as to the homologies with each other of the Placental and Marsupial teeth is one that will need much further, and especially palæontological, evidence for its solution; but comparing the dentition of *Triconodon* with those of both groups, it is difficult to avoid coming to the conclusion (1) that the changing tooth of Marsupials is homologous with the changing tooth, the fourth premolar, of *Triconodon*; (2) that the four premolars of *Triconodon* are homologous with the four premolars of the typical Placental dentition *; and, as a consequence, (3) that the changing premolar of Marsupials is homologous with $p.^4$ of Placental Mammals.

But if once the primitive diphyodont theory be admitted, the homologization of the Marsupial molars with the milk series is as likely as with the permanent, for originally all the teeth would have been in duplicate, the posterior as well as the anterior, and either set would be as likely to be suppressed as the other. And furthermore, if this homology of Dr. Kükenthal's is confirmed, and it seems well founded, in all probability the same will prove true of the Placental molars †, which we have as yet no real reason for knowing to be serially homologous with the permanent more than the milk set. In fact any presumption there may be one way or the other is rather in favour of the Placental Mammals having retained the same set as the lowlier and earlier Marsupials.

* Of course, as Mr. Bateson has shown (in his paper read before the Zoological Society on Feb. 2—not yet published), one may easily attempt to carry this principle of the individual homologization of teeth too far, as no doubt in my efforts to find a nomenclature by which we could name each Marsupial tooth I have myself done in my catalogue of that order. Still, without entering into this question before the publication of his paper, I may claim that the above is by no means a straining of the true principles of tooth homology.

One possibility, however, would take away the value of the above suggestion, namely if it were shown that neither *Triconodon* nor any of the other 4-premolared Mesozoic mammals were marsupials at all; but they have been considered as such by all palæontologists, and the changing of the last premolariform tooth is certainly not an argument against their being so.

† The close resemblance of $mp.^4$ to the molars both in form and structure has already suggested this homology to several observers, although it has hitherto usually been explained by the adaptive necessity for a grinding-tooth at the back of the tooth-row during youth.

I do not quite understand why, merely on account of the milk origin of the Marsupial molars, Dr. Kükenthal says of the Marsupials "there are no molars at all, but premolars," for the words molar and premolar in no way imply either difference or identity of series, and the "molars" are simply the non-changing posterior teeth either of Placentals or Marsupials, whether homologized with the milk or permanent series. In fact if the Placental molars are also of milk origin their complete homology with the Marsupial posterior non-changing teeth accentuates the right of the latter to bear the name "molar."

Should, again, further research prove this to have been the origin of the Placental molars, Dr. Kükenthal's extraordinary and, to all appearance, most unlikely theory as to the fusion of teeth of the permanent and milk sets in order to form the molars will fall to the ground *.

Of other interesting points in Dr. Kükenthal's papers a reference may be made to his theory as to the production by fission of the many simple unicuspid teeth of Cetacea out of compound multicuspid teeth, such as are found in other Mammals. Combined with the fact that real congenital fission does occasionally take place in Seals and other Mammals, as pointed out by Mr. Bateson †, this brilliant suggestion undoubtedly sheds a new light on the origin of Cetacean teeth, and Dr. Kükenthal may well be congratulated on his clever interpretation of the facts. At the same time his ideas on analogy and methods of evolution would appear to be somewhat peculiar when he describes as analogous to such a congenital fission the common mechanical wearing down of a seal's teeth to the roots, whence by the loss of the crown two "teeth" are formed out of each one. Such a multiplication of teeth may occur in any rooted-toothed animal if it only live long enough, and can hardly be considered more "analogous" to true fission than the cleavage of a man's jaw by a battle-axe is analogous to hare-lip.

Another way, and one perhaps more probable, by which Cetaceans may have obtained their numerous teeth is also rendered possible by Dr. Kükenthal's observations on their embryology. Instead of trusting to the comparatively rarely occurring fission, the ordinary process of hypsodontism applied to narrow multicuspid teeth, such as those of certain

* For all evidence as to this remarkable suggestion we have the mere statement "Beim ersten Molaren ist dies oft noch deutlich nachweisbar, besonders schön z. B. an Embryonen von *Spermophilus leptodactylus*."

† In the paper already referred to.

Seals *, might easily and naturally produce a large number of small separate teeth, united to each other in embryonic stages but separate in after life. The different laminæ of the elephant's molars, produced, as we know, simply by hypsodontism, are perfectly separate from one another until just before eruption, and might easily come up as separate teeth did the needs of the animal require it. And in the Cetacea the gradual † lengthening of the separate cusps, combined with firstly the later and later development, and finally the total disappearance, of the connecting "crown," would be a *modus operandi* so simple and so much in accord with what is now going on in many instances, that I think the balance of probability is rather in its favour as compared to the theory of multiplication based on spasmodic fission ‡. It is, however, difficult to see how the relative claims of the two suggestions can be adjusted, for Dr. Kükenthal's observations are equally consistent with either, and direct palæontological evidence on the subject we can hardly hope to obtain.

Dr. Kükenthal's suggestion of the converse of the fission process, *i. e.* the fusion of separate teeth, as a means whereby the comparatively few and compound teeth of Mammals might have sprung from the many simple teeth of Reptiles, strikes me, on the other hand, as being by no means so happy. Not only is its *modus operandi* almost inconceivable, and quite unlike anything that is now going on, so far as we can see, but it is also quite uncalled for, as the number of teeth in the primitive Mammalia, commonly from 14 to 16 on each side of each jaw, so far from being much less, is actually *more* than that found in many of the Anomodontia §, certainly the

* E. g. *Ogmorhinus*.

† Indeed this process is by no means necessarily very gradual or slow, for within the single genus *Procavia* we have both brachyodont and hypsodont species, while the closely allied genera *Gerbillus*, *Meriones*, and *Rhombomys* present us, in the order named, with a complete transition from brachyodont *Mus*-like teeth to perfectly hypsodont, rootless, ever-growing teeth, with the laminæ entirely distinct from one another throughout. The close alliance of these genera in other respects shows in how short a period of geological time such great dental changes may take place.

‡ The striking fact observed by Dr. Kükenthal of the identity in number of the cusps of the young compound teeth with the total number of the adult simple teeth is decidedly in favour of the method now suggested, but, on the other hand, the appearances presented by the teeth of the early Cetaceans, such as *Squalodon*, seem to be on the whole more suggestive of fission than development by hypsodontism.

§ Of the Dicynodontia there are either no marginal teeth at all or only a single pair, while of the Theriodontia *Cynosuchus* has 11 or 12, *Æluro-saurus* 8 to 10, and *Lycosaurus* 9 or 10, while *Empedias* has 14 to 16 and *Titanosuchus* 16 or 17 on each side of each jaw. See Lydekker, Cat. Foss. Rept. B. M. iv. pp. 71–101 (1890).

most Mammalian of all the Reptilia. This fact is alone sufficient to discredit Dr. Kükenthal's theory.

Dr. Kükenthal seems to credit the advocates of primitive monophyodontism with supposing that the present single dentition of the Cetacea is an unmodified survival of the earliest monophyodont condition; but this is not the case, that view having never been taken, so far as I know, by any one but Baume, and by him on the basis of a wholly different theory. I myself * have supposed the ancestors of the Cetacea to have passed through a more or less diphyodont stage, and to have afterwards lost one of their two sets of teeth.

Dr. Kükenthal is to be congratulated on the brilliant results that have attended his investigations, and I trust that he will continue his efforts to find out the true homologies of the different teeth, and thereby facilitate the work of those who for systematic purposes need to have correct names under which these important organs can be compared and described.

XLIX.—*On some undescribed* Cicadidæ, *with Synonymical Notes.* By W. L. Distant.

I have had submitted to me for identification a number of species belonging to this family contained in the collections of the South-African Museum at Cape Town and the Australian Museum at Sydney. The new species from these sources and others which I have recently received are here described, with a few synonymical notes and corrections resulting from some perfunctory and hasty work in other quarters. The legacy of bewilderment left to students of the Cicadidæ by the late Mr. Francis Walker is already so sufficing that it is earnestly to be hoped that such difficulties be not increased by other writers unfamiliar with the family. Like all other zoological groups Cicadidæ require study, but have, unfortunately perhaps, been as much obscured in printed matter as has proved to be the fate of most families of the Rhynchota.

Cicadinæ.

Pœcilopsaltria Trimeni, sp. n.

Head and pronotum fulvous and moderately pilose, meso-

* *T. c.* p. 458.